A Discussion of *Vexillum regina* (Sowerby, 1825) and Related Species, With Description of a New Subspecies

by

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(Plates 18, 19, 20; 1 Textfigure)

In the study necessary to ascertain that Vexillum coloscopulus J. Cate, 1961, was a hitherto undescribed species, I realized through an analysis of the works of many authors that at least five additional closely related species were included in the same complex; all are similar enough to have been either confused with one another or placed in synonymy. However, a careful diagnosis of the most outstanding characters of each species brought out that these six forms are confused chiefly because of their similarity of color, whereas the morphological differences, considered separately, provide a sufficient basis for separating them into six different categories.

It became apparent that a further study of the entire group was necessary in order to clarify the confusion encountered at every turn; I shall attempt here to outline the results of this study and illustrate the identifying features of each species in the hope that other collectors who have been similarly puzzled by this group may be able to identify their specimens without question.

The first species encountered in the study was Vexillum regina (Sowerby, 1825), as this was the name incorrectly applied to the specimen which is now the holotype of V. coloscopulus J. Cate, 1961. The next species to be considered in the course of comparing these shells was V. compressum (Sowerby, 1874), which at first glance appears to be a dwarf form of V. regina. Two additional species, V. taeniatum (Lamarck, 1811) and V. vittatum (Swainson, 1821), which are perhaps the two most difficult to separate, were included in the study because of their similarity in color and pattern and their superficial resemblance to V. regina. The final species, from the type locality of V. coloscopulus, is an intermediate form between that species and V. regina; this had been erroneously figured by Reeve, Sowerby, and Tryon as Mitra melongena Lamarck, 1811. This last form will be described here as a new subspecies of V. regina.

The important illustrated works on Mitridae are unfortunately few; the most complete of these, in chronological order, are by Kiener (1839); Küster (1841); Reeve (1844-45); Chenu (1860); Sowerby (1874); and Tryon (1882). There are also several helpful papers on the Mitridae of various Indo-Pacific localities, for example, Dautzenberg and Bouge (1922, 1933), and Dautzenberg (1935), but the approach in these papers is more in the nature of annotated geographical faunal lists rather than a complete monograph of the family, and consequently they do not include all the species under discussion here. Nevertheless, these are the most modern works on the group at the present time and provide much useful information. Other than the above-mentioned references and three or four important papers describing many new species but without illustrations, the only sources of information available on the worldwide Mitridae are scattered locality records or occasional descriptions of new species.

These works, therefore, formed the basis of the present study. Although numerous other references were consulted, those listed here were the only ones to contribute any information pertaining to the differences or similarities among the six species.

Vexillum regina (Sowerby, 1825)

(Plate 18, figures 1a, 1b; Plate 19, figure 1)

Type locality: China Seas

The original citation of Vexillum regina presents no technical description of any sort. In Genera of Shells Sowerby (1825) figured the

ventral aspect of this species as one of eight typical representatives of the genus Mitra; the only mention of its name appears in the caption to Plate 250 (op. cit.), merely as "4. Mitra Regina". This original figure, however, is an excellent illustration of the species and leaves no doubt as to its identity.

Kiener (loc. cit.) published fairly good likenesses of both dorsal and ventral views, although with some exaggeration as to the shell's specific characters; he included, however, a very complete description and cited the type locality as "China Seas".

Küster (loc. cit.) figured Vexillum regina rather well as compared with many of the other species in his "Conchylien-Cabinet", the chief fault with his illustration being a somewhat foreshortened last whorl which makes the spire appear exaggeratedly high. Küster's description is complete enough and cites the type locality as "The Chinese and Indian Oceans".

Reeve (loc. cit.) published only one view (this time the dorsal side) of the species, slightly more obese than normal but reasonably typical and well colored; his brief description is adequate except for ignoring the coarse, heavy surface ornament which is one of the species' most distinguishing features. Reeve correctly pointed out that Vexillum regina could be distinguished from V. taeniatum (Lamarck) "by the angular structure of the ribs near the sutures".

Chenu (loc. cit.) included a good representation of the species, correctly identified.

Nearly fifty years after the original publication of the species, Sowerby figured the ventral aspect of Vexillum regina in Thesaurus Conchyliorum, this time using a different, more perfect specimen for his illustration which reveals more brilliant colors than the original figure. He dismissed the species with only a brief reference to Genera of Shells and still furnished no written description but added the type locality as "Moluccas".

Tryon (loc. cit.) merely copied the second Sowerby figure, described the colors of the stripes on the shell, and mentioned its size and locality.

Vexillum regina may be readily recognized by its heavy, coarse sculpture, its slender, turriculate form with attenuated spire, its gradate sutural ramp, angular outlines, and constricted lip. This species has been recorded from Zanzibar and from the Andaman Islands, in addition to the Moluccas.

Vexillum compressum (Sowerby, 1874)
(Plate 18, figures 2a, 2b; Plate 19, figure 2)
Type locality: Moluccas

This species is encountered in the works of Chenu and Reeve prior to its description by Sowerby in 1874, though it is not recognized as distinct. Chenu indicated two different species under the name Vexillum taeniatum (Lamarck); one of these is V. compressum, the other a typical V. taeniatum. Reeve considered V. compressum merely the young state of V. taeniatum, though remarking at the same time upon its different form and recurved base; he based his judgment on the similarity of color and on its being found in the same locality. Tryon also included this species with V. taeniatum as a narrower, juvenile form.

Sowerby first recognized this small, rare form as a separate species, stating "it is much narrower and more attenuated and laterally compressed than M. regina, narrowed and recurved anteriorly." Examination of actual specimens of Vexillum compressum gives validity to Sowerby's convictions; the shells are almost like miniatures of V. regina, though a close inspection reveals the following differences: V. compressum is adult at about one-half to two-thirds the size of a typical adult specimen of V. regina; unlike that of V. regina, the spire of V. compressum is shorter than the last whorl, and there are many more raised labral lirae than in the typical V. regina. Its sutural ramp is more rounded, its early whorls are comparatively larger than those of V. regina despite its smaller size, the axial costae of the adapical whorls are smooth, not nodose, and finally the siphonal canal is more acutely curved in V. compressum and inclined in a different direction.

The Kiener and Küster monographs do not refer to the species.

Vexillum compressum has been recorded from the Philippine Islands, although the records are somewhat ambiguous in the light of its having been considered a synonym of V. taeniatum. Specimens included in the present study, however, were collected at Subic Bay, Davao, and Mindoro in the Philippines, giving some credence to the earlier records.

Vexillum coloscopulus J. Cate, 1961
(Plate 18, figures 3a, 3b; Plate 19, figure 3)
Type locality: Balabac Island, Philippines

This species differs from Vexillum regina in the following ways: the surface ornament is smoother and is continuous over the axial cos-

tae; the sutural ramp is rounded instead of gradate; the shape is more fusiform than turriculate; the aperture is straight, not constricted; there is no pseudumbilicus; there are several faint labral lirae instead of only a few raised ones, and the pattern arrangement and color are different. There is no central thread on the white band, the black areas are wide zones rather than narrow borders outlining the white band as in V. regina, and the white band, narrower than in the other compared species, is centrally placed on the adapical whorls.

No reference or illustration for this species was found in the early literature. It is presently known from only four specimens, the holotype from Balabac, two hypotypes which were collected in the Sulu Archipelago and at Zamboanga, and an additional specimen whose locality is given only as "Philippine Islands".

Of the three remaining species in the complex, the first rough scrutiny made it possible to divide the available specimens, on the basis of spire ornament, into two main groups. Certain of the specimens were seen to have many very closely-spaced, well-defined axial costae on the upper whorls, and fewer, flatter costae on the last whorl; the others possessed approximately the same number of axial costae on the last whorl as on the upper ones, and these were all equally sharply defined. After the two groups had been separated, it was interesting to note that the specimens with closely-spaced adapical costae had all been collected in Queensland, Australia, while the shells in the second group were all from the southern Philippines, mainly from Balabac Island or the adjacent Sulu Sea. It is the Philippine group which I consider a subspecies of Vexillum regina.

Further study after the first separation revealed additional morphological differences between the two groups; the Queensland shells were more obese, their spires proportionately shorter and less turriculate, their axial costae less pronounced and less regularly spaced, their colors less variable, and so on.

The next step was to identify the Queensland species; close study of this large group brought out two subgroups which could be separated from one another, first, by the interstitial striae present in one but lacking in the other; also by the more obese form and by the flatter, more numerous axial costae of one of these. It was then apparent that these two Queensland forms are the species respectively described as Vexillum taeniatum (Lamarck, 1811) and V. vittatum (Swainson, 1821). Vexillum vittatum has been considered a synonym of V. taeniatum by some workers, yet the diagnostic morphological characters of both seem clearly separable. The question remained as to whether these separating characters are sufficiently strong and numerous to define separate species.

Vexillum taeniatum (Lamarck, 1811)
(Plate 18, figures 4a, 4b; Plate 19, figure 4)
Type locality: Indian Ocean

Lamarck's original description of Vexillum taeniatum is somewhat sketchy, though his reference to a figure in the Encyclopédie Méthodique and one phrase in his description definitely separate this species from the others: this is his reference to "petites côtes longitudinales, obtuses, fréquentes, peu élevées, et de stries transverses qui ne paroissent bien qu' entre les côtes". This is the only species of the six under consideration which possesses transverse interstitial striae; in the other species the spiral ornament is continuous, even though in V. regina this ornament is nodose where it intersects the costae. Therefore, one of the two Queensland species can be definitely identified as V. taeniatum. All of the available study specimens which I have assigned to this species agree closely with the original description, and with the figure in the Encyclopédie Méthodique referred to by Lamarck. Other separating features include a more obese form, more closely-spaced, flatter axial costae on the last whorl, and a rounded sutural ramp.

Kiener illustrates dorsal and ventral views of what may have been Lamarck's holotype of Vexillum taeniatum, clearly showing emphasis on the obese form and interstitial striae which are its most important diagnostic features.

Reeve's two illustrations labelled Vexillum taeniatum leave much to be desired: one (Conch. Icon., fig. 52a) represents a fine specimen of V. compressum (Sowerby), the other (ibid., fig. 52b) adequately indicates the general shape of V. taeniatum but fails to show the interstitial striae. Reeve considered V. compressum merely a juvenile example of V. taeniatum, apparently overlooking the several morphological differences between these two species.

Küster illustrated this species with exaggerated drawings but fortunately emphasized the important characters.

Chenu followed Reeve's error in considering Vexillum taeniatum and V. compressum synonymous; he illustrated both species very

Fig. 1 a
Vexillum r. regina

Fig. 2 a
V. compressum

Fig. 3 a
V. coloscopulus

Fig. 4 a
V. taeniatum

Fig. 5 a
V. vittatum

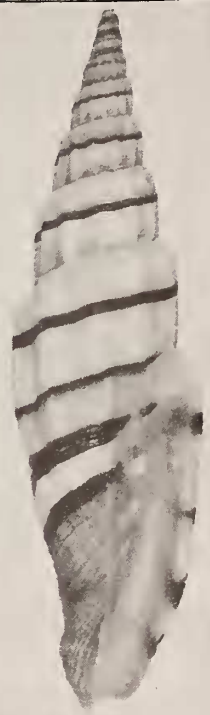

Fig. 6 a
V. r. filiareginae

Fig. 1 b

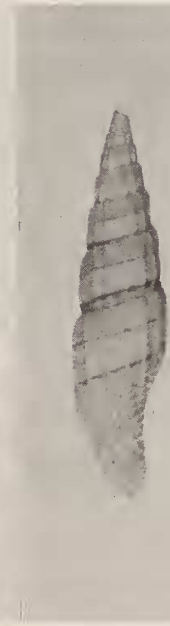

Fig. 2 b

Fig. 3 b

Fig. 4 b

Fig. 5 b

Fig. 6 b

PIERSON, OSWALD, & PIERSON, *photo.* except Figures 1a & 1b: Courtesy of Stanford University

Figure 1
Vexillum r. regina (SOWERBY)

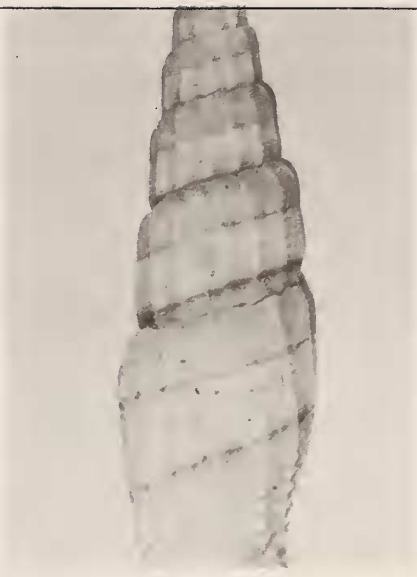

Figure 2
Vexillum compressum (SOWERBY)

Figure 3
Vexillum coloscopulus J. CATE

Figure 4
Vexillum taeniatum (LAMARCK)

Figure 5
Vexillum vittatum (SWAINSON)

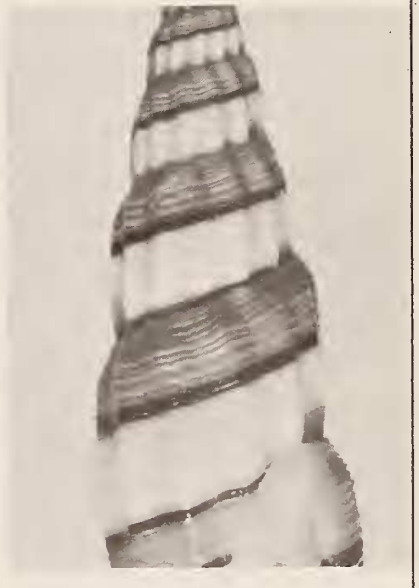

Figure 6
Vexillum r. filiareginae subsp. nov.

Photographic enlargements showing distinctive sculpture

PIERSON, OSWALD, & PIERSON, *photo.*

well but applied the name V. taeniatum in both instances.

Sowerby's Thesaurus Conchyliorum is the only monograph to illustrate four of the discussed species in accordance with their original descriptions; two of these four are Sowerby species, but the excellent color plates also clearly point out the differences between Vexillum taeniatum and V. vittatum.

Tryon's contribution will be covered under the section on Vexillum vittatum; he considered all the species in this complex synonymous, with the exception of V. regina.

Vexillum taeniatum has been recorded from Madagascar; Bombay; Moluccas; Mindoro, Masbate, and Cebu in the Philippines; Maurice Island, and Queensland.

Vexillum vittatum (Swainson, 1821)
(Plate 18, figures 5a, 5b; Plate 19, figure 5)
Type locality: Pacific Ocean

Swainson's original description of this species mentions "interstices with slender, crowded, transverse grooves", but the accompanying poorly-colored figure of the holotype does not indicate these, nor are they visible in two out of three of Reeve's poor figures, in Kiener's, Küster's, Sowerby's, nor in Dautzenberg's (1935) excellent illustration, the only actual photograph of this species to appear in the literature. All these monographers represent Vexillum vittatum with continuous spiral sculpture over the high points of the costae.

Küster's stylized ventral view presents a recognizable illustration of Vexillum vittatum and his description is adequate.

Tryon placed Vexillum vittatum in synonymy with V. taeniatum, along with V. compressum (Sowerby), V. coccineum (Reeve), and V. taylorianum (Sowerby), copying the obviously different type figures of all these species but asserting that they are identical.

Dautzenberg (1935) nearly arrived at the solution to the problem of separating Vexillum vittatum from V. taeniatum, saying "if it is true that these species resemble one another by the disposition of their pattern and their coloration, they differ considerably by the form and the sculpture; M. vittata having more angled whorls, the latter whorl larger; the axial folds are much heavier and more projecting on the last whorls." However, he then included in his illustration of V. vittatum both that species and V. taeniatum under the same name, thereby confusing the issue even more than before. Instead of illustrating the species V. vittatum as he intended, his figures afford a fine comparison of V. vittatum (Dautzenberg, 1935, Pl. 4, fig. 3) with V. taeniatum (ibid., Pl. 4, fig. 4). On the same plate Dautzenberg also illustrated V. coccineum (Reeve, 1844) under the questionable combined name of V. taeniatum coccineum (Reeve) — a combination difficult to understand when both names apply to separate, established species, thereby further complicating the problem of identifying the typical V. taeniatum.

The basic differences between Vexillum vittatum and V. taeniatum are few but easily enough defined if one disregards the similarity of color and pattern, as may be seen by the accompanying black-and-white photographs on Plate 19, figures 4 and 5. While the adapical whorls of both species indicate interstitial striae, in V. vittatum these striae become continuous on the last whorl (sometimes on the penultimate whorl as well) and are not interrupted by the axial costae. Vexillum vittatum is more shouldered and the base is more angulate than in V. taeniatum. The closely spaced adapical costae become more distant with maturity in V. vittatum, reducing in number from approximately 20 on the antepenultimate whorl to about six on the last whorl; in V. taeniatum the number of costae remains more or less constant on all the whorls. The tendency among the specimens studied seems to be for the spire length to be about equal to the last whorl in V. vittatum, slightly shorter than the last whorl in V. taeniatum, though this characteristic cannot be considered definitive in view of the small number of specimens studied.

The lack of spiral ornament just below the sutures which is so apparent in the enlarged photograph (Plate 19, figure 5) should be disregarded as a diagnostic character as it is not constant among the specimens studied, nor is it as prominent on the photographed specimen as the photograph indicates.

With the above five species adequately identified, a sixth group remained which possessed certain traits common to several of the others but still did not fit all of the characteristics of any one of them, nor was it encountered in the literature except as a wrongly labelled figure. Since a fairly large sample (34 specimens) of this particular group was avail-

able for study, all consistently exhibiting the same morphological features exclusive of color, this form is considered a separate taxon and is here described as a new subspecies.

VOLUTACEA
MITRIDAE
Vexillinae
Vexillum RÖDING, 1798
Vexillum regina (SOWERBY, 1825)
Vexillum regina filiareginae J. CATE, subspec. nov.
(Plate 18, figures 6a, 6b; Plate 19, figure 6; Plate 20, figures 1a - 10a, 1b - 10b)

Shell long, straight, slender, turriculate-fusiform; spire about as long as the last whorl. Protoconch lacking; (three to four postnuclear whorls eroded by acid in the holotype); teleoconch of about nine straight-sided oblique abutting whorls; shoulders obtusely rounded. Axial sculpture of raised equidistant collabral costae (about 12 on the penultimate whorl) whose ridges and valleys are of about equal depth, forming a regular, zigzag pattern when viewed from the apex; costae not regularly aligned between sutures; proportionately the same number of costae on adapical whorls as on last whorl. Spiral ornament of low cords, rounded, crenulate, narrow and crowded below the sutures, flattened into wider bands at periphery, again becoming rounded, narrower and wrinkled at lower part of neck; all spiral cords separated by smooth, shallow impressed striae and crossed by faint, irregularly spaced orthocline rugae. Aperture straight, siphonal canal slightly recurved; labrum thickened, constricted (adapical edge chipped in holotype); number of labral lirae variable (usually three to six raised lirae and several faint abapical lirae present). Parietal ridge present; columella straight; three to five oblique columellar folds, greatly diminishing in strength abapically; peristome continuous, pseudumbilicus and siphonal fasciole faintly produced.

Color of holotype white, with four narrow black spiral bands on last whorl; neck of shell below abapical band orange (Maerz & Paul Dictionary of Color, 1st Edition, 1930; Plate 12, J-12). Color of paratypes variable; numbers 1-4 and 10-13 similar to holotype, but neck and one narrow spiral band sometimes dark orange to dark gray. Paratypes 5-8 and 14-32 predominantly orange-brown, with one wide and one narrow white spiral band on last whorl; Paratype 9 is black with two white bands. In all specimens the wide white spiral band is contiguous to abapical sutures and approximately six cords wide; the narrower band, about half as wide, is always immediately above the adapical columellar fold adaxially and borders the upper part of the neck; a central yellow thread present on wide white band in about half the specimens. Aperture color white to cream; color pattern visible through translucent labrum.

Animal of the species unknown.

Measurements of the holotype: Height, 66.4 mm.; Greatest diameter, 18.1 mm.; Length of aperture, 34.9 mm.

The type locality of Vexillum regina filiareginae is here designated as Cape Melville, Balabac, Philippine Islands (7° North Latitude, 117° East Longitude).

The name filiareginae means "daughter of the queen", or princess — a name considered suitable for a species closely related to Vexillum regina. Since V. regina filiareginae has so long been confused with the older, more familiar V. regina, it was made a subspecies of this form rather than of the new species V. coloscopulus, to which it is as closely related.

When the preliminary study for this paper was nearing completion and the photographs of the first ten specimens listed below had been taken, an additional shipment of 22 newly collected specimens of Vexillum regina filiareginae from Balabac was sent to me by Mr. Fernando Dayrit of Manila. Still later one important additional specimen was discovered in the collection of Mr. and Mrs. John Q. Burch, this shell having been unavailable earlier. The Burch specimen is identical with the orange-colored paratypes from Balabac, particularly resembling Paratype 6 (Plate 20, figures 7a, 7b). Its locality, however, is reported as Mozambique, East Africa — approximately 8° of latitude southward and 77° of longitude westward, or a distance of roughly 5,500 statute miles in a southwesterly direction from the type locality. This locality record would seem to establish a tentative range for the subspecies from Mozambique to Zamboanga. An even wider range may come to light as more specimens are reported.

The latter 23 specimens were included in the study and designated as paratypes, though they do not appear in the photograph on Plate 20 as they were received too late for processing.

The most variable of the six taxa under discussion, Vexillum regina filiareginae combines some of the morphological features of V. coloscopulus and some of those of V. regina and may be a link between these two species